(d) controlling the performance of the steps (a), (b), and (c) to enhance, in the output produced, the selectivity of said nerve, while the nerve is living in the *in vivo* region of the subject; and

(e) processing the output to generate a data set describing the shape and position of said nerve, said data set distinguishing said nerve from non-neural tissue in the *in vivo* region to provide a conspicuity of the nerve that is at least 1.1 times that of the non-neural tissue, without the use of neural contrast agents.

B1

8 ~~93~~. (Amended) The method of Claim ~~92~~ 7, wherein the step of subtracting further includes the step of determining [the] a registration between the first output and the second output.

D B2

10 ~~95~~. (Amended) The method of Claim ~~92~~ 7, wherein the non-neural tissue includes fat, and wherein the method includes the step of exposing the *in vivo* region to electromagnetic fields that suppress the contribution of the fat in said first and second outputs prior to the steps exposing the *in vivo* region to said first and second gradients[, the *in vivo* region is exposed to electromagnetic fields that suppress the contribution of the fat in said first and second outputs].

D B3

111. (Amended) The method of Claim 110, wherein [said steps (a), (b), and (c) to produce a first output in which] the contribution of nerve is enhanced in said output and [as] said steps (a), (b), and (c) are performed a second time to produce a second output in which the contribution of blood vessels is enhanced, [and] wherein said step (e) of processing the output includes the step of processing [the first and] said output and said second output[s] to suppress the blood vessels from said data set.

(C5) B4

36 ~~120~~. (Amended) A method of utilizing magnetic resonance to determine the shape and position of a structure, said method including the steps of:

(a) exposing a region to a magnetic polarizing field including a predetermined arrangement of diffusion-weighted gradients, the region including a selected structure that exhibits diffusion anisotropy and other structures that do not exhibit diffusion anisotropy;

B5

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(b) exposing the region to an electromagnetic excitation field;

(c) for each of said diffusion-weighted gradients, [producing an output indicative of the region's] sensing a resonant response of the region to the excitation field and the polarizing field including the diffusion-weighted gradient and producing an output indicative of the resonant response; and

B5 Cont.

(d) vector processing said outputs to generate data representative of anisotropic diffusion exhibited by said selected structure in the region, regardless of the alignment of said diffusion-weighted gradients with respect to the orientation of said selected structure; and

(e) processing said data representative of anisotropic diffusion to generate a data set describing the shape and position of said selected structure in the region, said data set distinguishing said selected structure from other structures in the region that do not exhibit diffusion anisotropy.

B6

56 ~~135~~. (Amended) A method of utilizing magnetic resonance to determine data representative of diffusion anisotropy exhibited by a structure, said method including the steps of:

(a) exposing a region to a suppression sequence of electromagnetic fields that suppresses the electromagnetic responsiveness of structures in the region that do not exhibit diffusion anisotropy, so as to increase the apparent diffusion anisotropy of structures in the region that exhibit diffusion anisotropy, said suppression sequence of electromagnetic fields not including diffusion-weighted magnetic gradients;

(b) exposing the region to a predetermined arrangement of diffusion-weighted magnetic gradients, said predetermined arrangement of diffusion-weighted magnetic gradients chosen to:

i) emphasize a selected structure in the region exhibiting diffusion anisotropy in a particular direction; and

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ii) suppress other structures in the region exhibiting diffusion anisotropy in directions different from said particular direction;

(c) for each of said diffusion-weighted gradients, [producing an output indicative of the region's] <u>sensing a</u> resonant response <u>of the region</u> to the diffusion-weighted gradient <u>and producing an output indicative of the resonant response</u>; and

B6 cont.

(d) processing said outputs to generate data representative of the diffusion anisotropy of the selected structure.

139. (Amended) A magnetic resonance apparatus for determining the shape and position of mammal tissue, said apparatus including:

B7

(a) [a] polarizing field source <u>means</u> for exposing an *in vivo* region of a subject to a magnetic polarizing field, the *in vivo* region including non-neural tissue and a nerve, the nerve being a member of the group consisting of peripheral nerves, cranial nerves numbers three through twelve, and autonomic nerves;

(b) [an] excitation and output arrangement <u>means positioned near said polarizing field source means</u> for exposing the subject to an electromagnetic excitation field;

(c) [a] sequence controller <u>means coupled to said polarizing field source means and said excitation and output arrangement means</u> for controlling the operation of said polarizing field source <u>means</u> and said excitation and output arrangement <u>means</u> so that the polarizing field and the excitation field cooperatively induce a resonant response in the *in vivo* region to enhance the selectivity of said nerve while the nerve is *in vivo* and living, said excitation and output arrangement <u>means</u> further for <u>sensing the resonant response of the *in vivo* region and</u> producing an output indicative of the resonant response of the *in vivo* region at a time determined by said sequence controller <u>means</u>; and

(d) [a] processor <u>means</u> for processing said output to produce a data set describing the shape and position of said nerve, said data set distinguishing the nerve from non-neural tissue in

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B7 cont'd

the *in vivo* region to provide a conspicuity of the nerve that is at least 1.1 times that of the non-neural tissue, without requiring the use of neural contrast agents.

140. (Amended) The apparatus of Claim 139, wherein said excitation and output arrangement means includes a phased-array coil system.

B8

55 150. (Amended) A magnetic resonance apparatus for determining the shape and position of a structure, said apparatus including:

(a) [a] polarizing field source means for exposing a region to a magnetic polarizing field including a predetermined arrangement of diffusion-weighted gradients, the region including a selected structure that exhibits diffusion anisotropy and other structures that do not exhibit diffusion anisotropy;

(b) [an] excitation and output arrangement means positioned near said polarizing field source means for:

i) exposing the region to an electromagnetic excitation field; and

ii) [producing,] for each of said diffusion-weighted gradients, [an output indicative of the region's] sensing a resonant response of the region to the excitation field and the polarizing field including the diffusion-weighted gradient and producing an output indicative of the resonant response; and

(c) [a] processor means coupled to said excitation and output arrangement means for:

i) vector processing said outputs to generate data representative of anisotropic diffusion exhibited by the selected structure in the region, regardless of the alignment of said diffusion-weighted gradients with respect to the orientation of said selected structure; and

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B cont'd

ii) processing said data representative of anisotropic diffusion to generate a data set describing the shape and position of said selected structure in the region, said data set distinguishing said selected structure from other structures in the region that do not exhibit diffusion anisotropy.

B9

57 ~~152.~~ (Amended) The apparatus of Claim ~~151~~ 56, wherein :

said processor means is further for analyzing said data representative of anisotropic diffusion to determine an effective direction of the anisotropic diffusion exhibited by said neural tissue, so as to determine an optimal orientation for diffusion-weighted gradients;

said polarizing field source means is further for exposing the region to two additional diffusion-weighted gradients respectively substantially parallel to and substantially perpendicular to said effective direction;

said excitation and output arrangement means is further for producing two additional outputs indicative of the region's resonant responses respectively to said two additional diffusion-weighted gradients; and

said processor means is further for determining the difference between said two additional outputs to generate said data set describing the shape and position of said neural tissue.

58 ~~153.~~ (Amended) The apparatus of Claim ~~151~~ 56, wherein said data set describing the shape and position of said neural tissue describes the shape and position of a selected cross section of said neural tissue, and said apparatus is further for generating additional data sets describing different cross sections of said neural tissue, and said processor means is further for calculating a further data set that describes the three dimensional shape and position of a segment of said neural tissue by:

analyzing the data representative of anisotropic diffusion to determine how to relate said data set and said additional data sets describing the shape and position of cross sections of said neural tissue; and

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based upon the results of said analyzing the data representative of anisotropic diffusion, combining said data set and said additional data sets to generate said further data set that describes the three dimensional shape and position of the segment of said neural tissue, thereby allowing a three dimensional shape and position of curved neural tissue to be described.

B9

60 ~~155~~. (Amended) The apparatus of Claim 55 ~~150~~, wherein:

B10

said processor means is further for analyzing said data representative of anisotropic diffusion to determine an effective direction of the anisotropic diffusion exhibited by said selected structure, so as to determine an optimal orientation for diffusion-weighted gradients;

said polarizing field source means is further for exposing the region to two additional diffusion-weighted gradients respectively substantially parallel to and substantially perpendicular to said effective direction;

said excitation and output arrangement means is further for producing two additional outputs indicative of the region's resonant responses respectively to said two additional diffusion-weighted gradients; and

said processor means is further for determining a difference between said two additional outputs to generate said data set describing the shape and position of said selected structure.

61 ~~156~~. (Amended) The apparatus of Claim 55 ~~150~~, wherein said data set describing the shape and position of said selected structure describes the shape and position of a selected cross section of said selected structure, and said apparatus is further for generating additional data sets describing different cross sections of said selected structure, and said processor means is further for determining a further data set that describes the three dimensional shape and position of a segment of said selected structure by:

analyzing the data representative of anisotropic diffusion to determine how to relate said data set and said additional data sets describing the shape and position of cross sections of said selected structure; and

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B10 cont.

based upon the results of said analyzing the data representative of anisotropic diffusion, combining said data set and said additional data sets to generate said further data set that describes the three dimensional shape and position of the segment of said selected structure, thereby enabling a three dimensional shape and position of curved structure exhibiting anisotropic diffusion to be described.

B11

54 ~~158~~. (Amended) A magnetic resonance apparatus for determining data representative of the diffusion anisotropy exhibited by a structure, said apparatus including:

(a) [an] excitation and output arrangement <u>means</u> for exposing a region to a suppression sequence of electromagnetic fields that suppresses the electromagnetic responsiveness of structures in the region that do not exhibit diffusion anisotropy, so as to increase the apparent diffusion anisotropy of structures in the region that exhibit diffusion anisotropy, said suppression sequence of electromagnetic fields not including diffusion-weighted magnetic gradients;

(b) [a] polarizing field source <u>means positioned near said excitation and output arrangement means</u> for exposing the region to a predetermined arrangement of diffusion-weighted magnetic gradients chosen to:

i) emphasize a selected structure in the region exhibiting diffusion anisotropy in a particular direction; and

ii) suppress other structures in the region exhibiting diffusion anisotropy in directions different from said particular direction, said excitation and output arrangement <u>means</u> further for [producing, for each of said diffusion-weighted gradients, an output indicative of the region's] <u>sensing a</u> resonant response <u>of the region</u> to the diffusion-weighted gradient <u>and producing an output indicative of the resonant response, for each of said diffusion-weighted gradients</u>; and

(c) [a] processor <u>means coupled to said excitation and output arrangement means</u> for processing said outputs to generate data representative of the diffusion anisotropy of the selected structure.

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